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Performance and modeling of check dams in the large desertification area of Gilbués, Brazil

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Brazil has a large area vulnerable to desertification, home to almost 30 million inhabitants. In the Northeast of the Country, there is the largest continuous area under severe desertification: the Gilbués site, with almost 8,000 km^2, involving 15 municipalities. The reforestation nucleus NUPERADE constructed almost one hundred check dams in the site. It is not known, up to now, to what extent these works have provided effective environmental services. Besides, it is necessary to have a simple but consistent model capable of assessing the siltation process within the check dams. The objective of this work is, therefore, to investigate the dynamics of sediments (of different grain sizes) in the dams; to describe its main physical processes; and to model the enrichment of fine grains and the critical particle diameter based on the principle of maximum entropy (PME). The PME can be very helpful to solve this problem, considering the high uncertainties involved in the processes, despite the small size of the dams. The study area is a 30 ha watershed inside the Gilbués site, whose climate is Aw – tropical sub-humid with excessive rainfall from December to April. The watershed encompasses 86 check dams, which have been under operation for almost a decade. The method consists of six steps: (i) monitoring two (one in a fully degraded and one in a partially degraded hillslope) Wischmeier plots (3 x 22 m^2) using metal pins (30 cm long) with a density of one pin per m^2; (ii) seasonal topographic control of the watershed, including all check dams, with a high-precision unmanned flying vehicle; (iii) control of the water and sediment fluxes by the watershed outlet using a Parshall flume and a turbidimeter; (iv) seasonal control of the grain-size distribution within the check dams; (v) modeling of the fine sediment enrichment from the hillslopes to the check dams; and (vi) modeling of the critical silting diameter using the principle of maximum entropy.